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76A8B24064E25634FA3AF7DD5742DA88

Title:	Nomenclatures for the HITRAP Facility Beyond the FAIR-CS Controlled Transfer Beamline.
Purpose:	Definition and consolidation of nomenclatures for elements of the HITRAP facility which are controlled by the HITRAP-specific control system.
Organizational Unit:	Decelerators (DEC)
Valid For:	HITRAP components controlled by HITRAP control system - i.e. control system NOT provided by FAIR CS group.
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Requirements:	Document class FAIRControlledDocument.cls v2.0 (24.01.2022)

Document History:

Version	Author, Date	Reviewer, Date	Approver, Date	Comment
0.5	W. Geithner, 06.09.2021			First draft, distributed to reviewers
0.5.1	W. Geithner, 09.09.2021	Frank Herfurth		Integrated feedback from reviewer
0.6	W. Geithner, 14.09.2021			Added Shared Variable assignment schema
0.6.1	W. Geithner, 15.09.2021			Enhanced beamline schema by EBIT beamline
0.6.2	W. Geithner, 16.09.2021	Maria Kühn, Simon Rausch		Incorporated changes suggested by reviewers.
0.6.3	W. Geithner, 20.09.2021			Errors in cooler trap variable assignment.
0.6.4	W. Geithner, 23.09.2021	Max Horst, Simon Rausch		Errors in GTR5Lx6 steerer nomenclatures, prelim assignment of power supplies.

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0.6.5	W. Geithner, 29.09.2021			Errors in nomenclatures in figure 4
0.7.0	W. Geithner, 01.12.2021	Max Horst, 30.11.2021		Correction of device orders in beamline schemas, updates of share-variable connections.
0.7.1	W. Geithner, 06.12.2021	Max Horst, 06.11.2021		Update of SV-connections according to M. Horst's as-is analysis of cabling / Excel.
1.0.0	W. Geithner, 21.01.2022			Adjustment of document to synchronize with Database, missing devices, wrong devices.
1.0.1	W. Geithner, 24.01.2022			Update of figure 1 (ESR-to-HTR beamline schema) with legend and version info.

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Contents

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1 Purpose and classification of the document

This document refines/defines nomenclatures of beam-optical elements of the HITRAP facility controlled by the HITRAP-specific control system+. Furthermore, this documents provides details on the relations between nomenclature (= physical device) and software variables used in the context of the HItrap control system.

2 Abbreviations, Terms and Definitions

Abbr.	Long Text	Comment
CSPP	Control System Plus Plus	HITRAP control system base layer
HCS	HITRAP Control System	
LV	National Instruments LabVIEW	development framework
SV	Shared Variable	variable in NI-specific communication layer

3 Introduction

The nomenclatures for the HITRAP beamline and facility were defined in 2008 [1], [2], [3] and remained unchanged until 2021. With activities to get the HITRAP control system operational for the commissioning beam time in Q1/Q2 2022, it became evident that the control system requires adjustments and streamlining with the FAIR nomenclature guideline [4] which was not yet available in its current depth in 2008.

Part of the renaming process was as well to rename the elements in the transfer beamline between ESR and HITRAP, controlled via the FAIR control system [5]. The corresponding schematic drawing of the beamline is given in figure 1

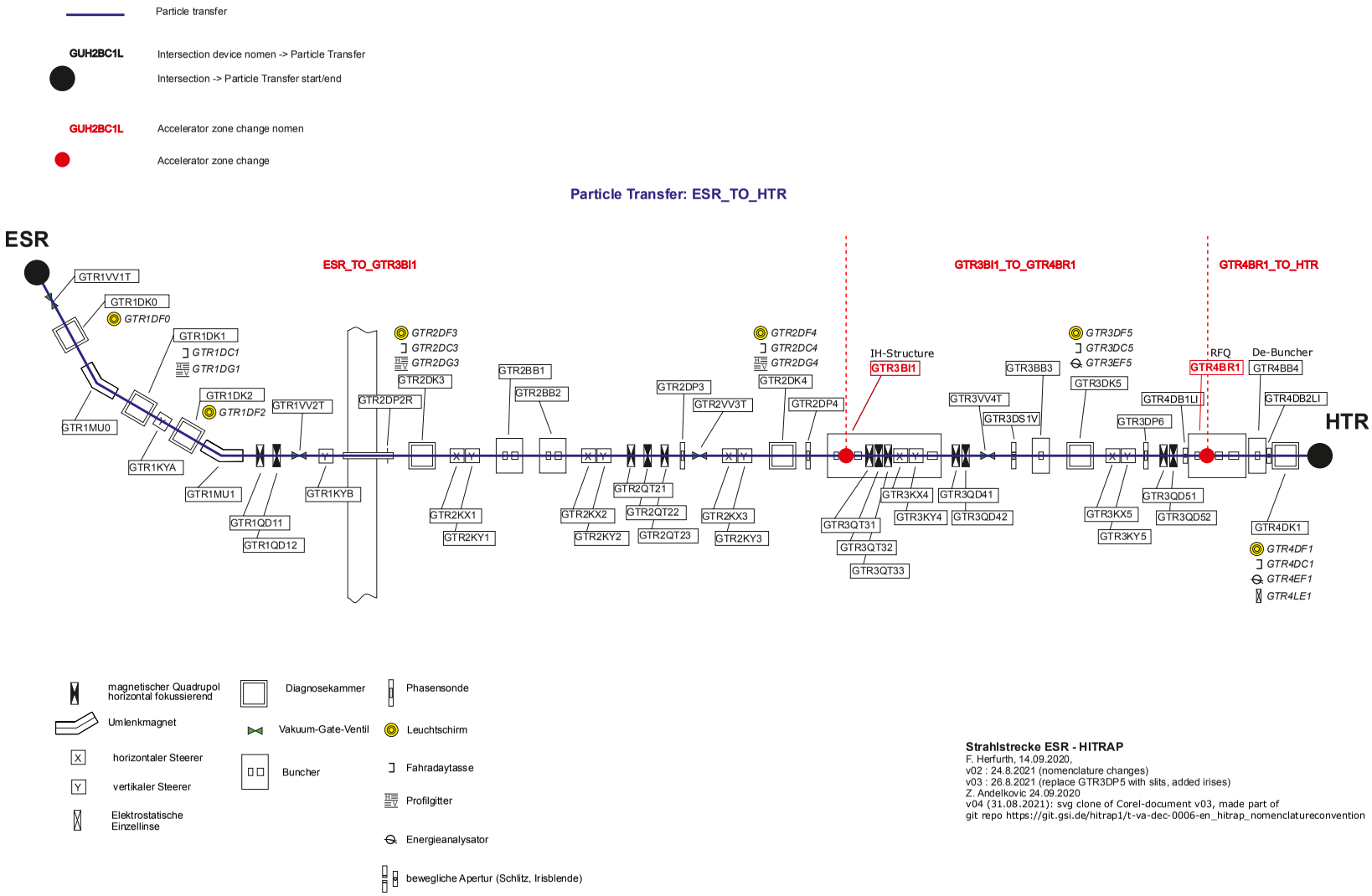

Figure 1: Schematic overview of transfer beamline between ESR and HITRAP. This part of the beamline is controlled via the FAIR control system.

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As end-point for the beamline part under FAIR control system control, the valve with nomenclature GTR5VV1T. All elements beyond GTR5VV1T are under control of the HIRAP local control system. The remaining part of the document will deal with these elements under HITRAP CS control.

4 General Naming Considerations

The beamline elements with prefixes GTR5 and GTR6 - the “Hitrap” elements in the narrow sense - comprise the following beam optics element types which shall to be named in line with [4]. Up to now, the naming of elements was according to very early versions of the FAIR nomenclature convention or partly by using “colloquial” identifiers. Standard element types are listed in table 2.

Table 2: Standard element types used in the HITRAP beamline together with their nomenclature stereotypes.

Type	Nomenclature Stereotype	Chapter in [4]
Diagnostic element “Faraday Cup”	- - - - DC	5.5
Diagnostic element “Fluorescence Screen”	- - - - DF	5.5
Electrostatic Einzellens	- - - - LE	5.10
Electrostatic Steerer	- - - - LH(- S), - - - - LV(- S)	5.10
Magnetic Steerer	- - - - KX, - - - - KY	5.9
Vacuum gauge: combi	- - - - VM - C	5.17
Vacuum pump: ion getter	- - - -VP - I	5.17
Vacuum pump: turbo	- - - -VP - T	5.17

Details to the nomenclatures of standard elements can be found in the Excel workbook “HITRAP_NomenclatureProcessVariableMapping.xlsx” [6]. This Excel workbook contains columns A - K with meanings given in table 3.

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Table 3: Meaning of columns in Excel workbook containing old and updated nomenclatures [6].

Column	Column Meaning
A	Nomenclature of element defined in 2008 in references [1], [2], [3]
B	Nomenclature grouping/containing element in column A. i.e. normally a vacuum chamber
C	Updated nomenclature where required
D	Description
E	INI-file name in HITRAP-CS containing reference to SV connected with nomenclature
F	LV VI library/class defining interface to shared variable in CSPP
G	Shared variable definition: voltage SET (read, write)
H	Shared variable definition: actual voltage GET (read)
I	Shared variable definition: current SET (read, write)
J	Shared variable definition: actual current GET (read)
K	Shared variable definition: ON/OFF (read, write)

A schematic overview of the beamline sections GTR5 and GTR6 with revised nomenclatures is given in figure 2. The schema used in this document is a bitmap version of the vector graphics file [7]. The rather complex electrode structure between the RFQ and the so-called “cooler trap” (GTR5BT1) is depicted in figure 3.

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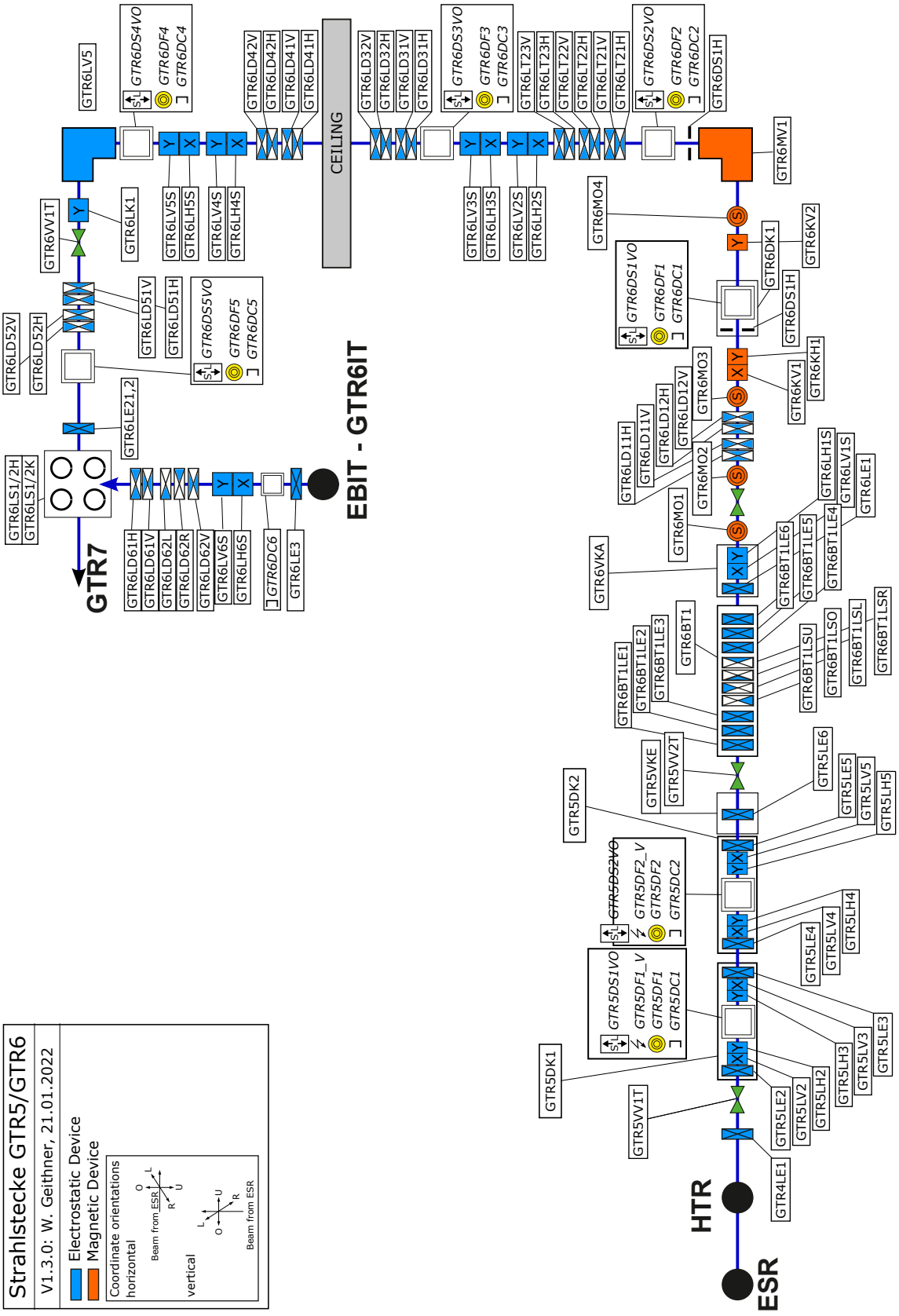

Figure 2: Schematic overview of beamline sections GTR5 and GTR6 with harmonized nomenclatures. This part of the beamline is controlled via the HITRAP control system.

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4.1 Details of Sub-Section GTR5

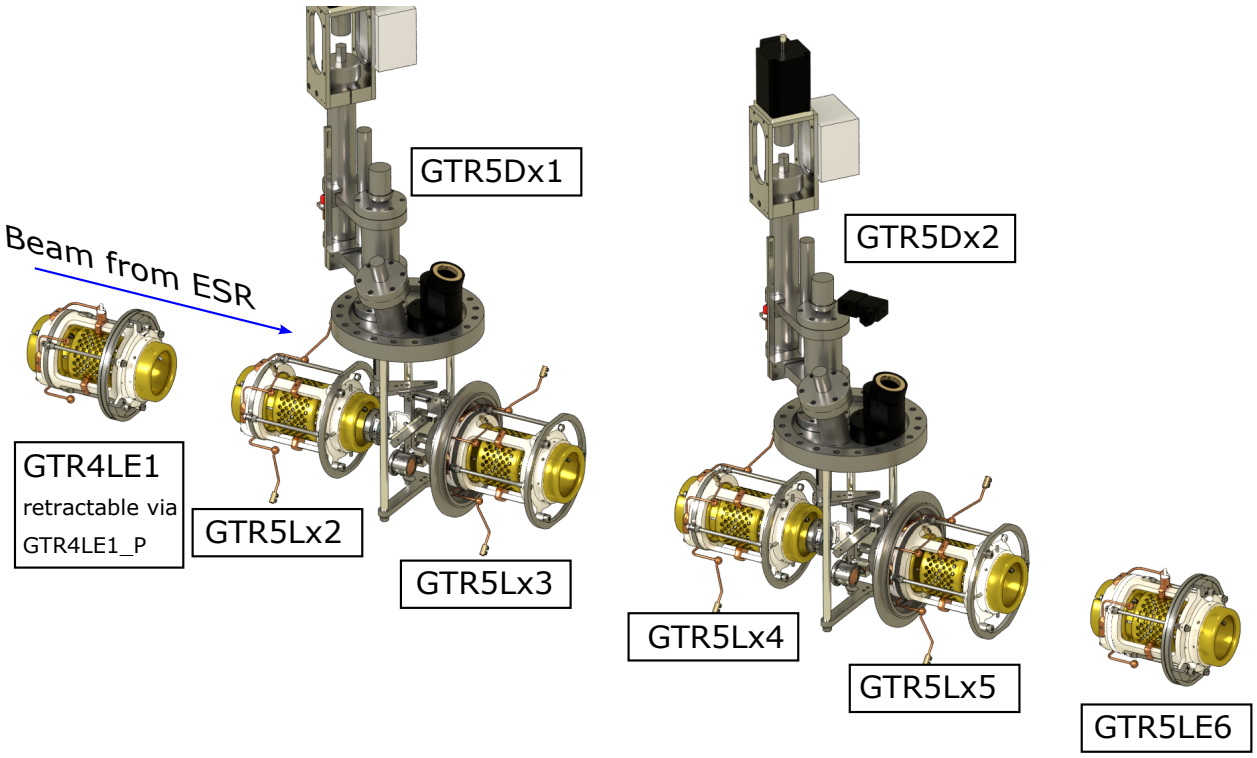

Figure 3: Electrode structure of the “LEBT” beamline between RFQ de-celerator and cooler trap. Note that the ”x” in the nomenclatures listed here are meant as a placeholder for actual character code in the nomenclatures: GTR5L*E*2, GTR5L*H*2, GTR5L*V*2, etc.

5 Naming Convention for Cooler Trap Elements

The so-called “cooler trap” (subsystem with nomenclature GTR6BT1) comprises a couple of electrodes which are not covered by standard FAIR nomenclature semantics. Hence, we use nomenclatures of the “L” (electrostatic element) stereotype.

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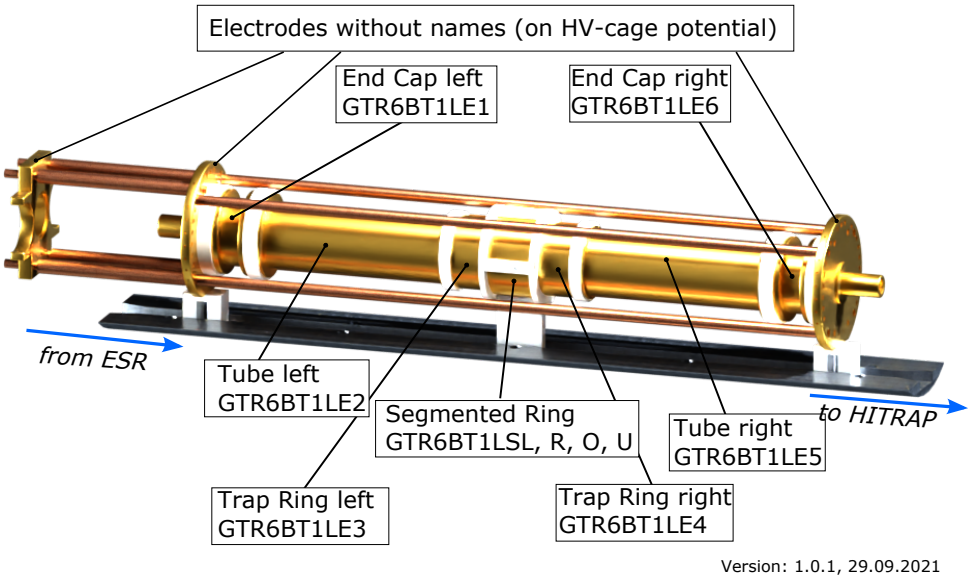

Figure 4: Electrode structure of the so-called “cooler trap” GTR6BT1 with related nomenclatures for the individual electrodes.

6 Naming Convention for Local EBIT Ion Source

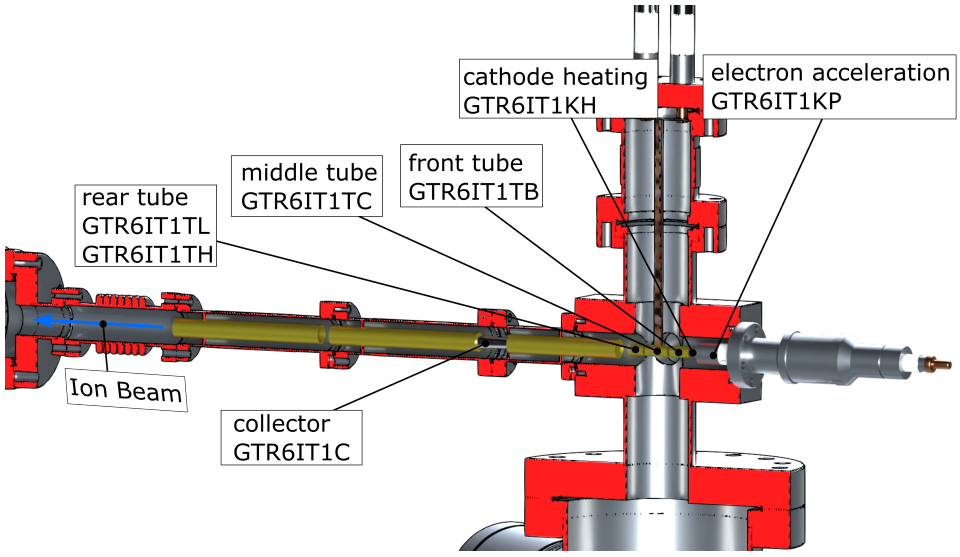

Figure 5: Electrode structure of HITRAP local EBIT with related nomenclatures assigned.

Another subsystem having a mostly “colloquial” naming convention is the EBIT ion source on the HITRAP platform. This source is used for local testing and local experiments. As up to now the EBIT electrodes were not assigned to nomenclatures following the FAIR systematics, nomenclatures

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were assigned following chapter 5.7 “Ion Sources, Laser, Electron Guns” of [4]. An illustration of nomenclatures assigned to electrodes is given in figure 5

For the beamline connecting the EBIT ion source to the rest of the HITRAP facility, the nomenclature situation was as well rather heterogeneous. A harmonized nomenclature assignment is given in figure 6.

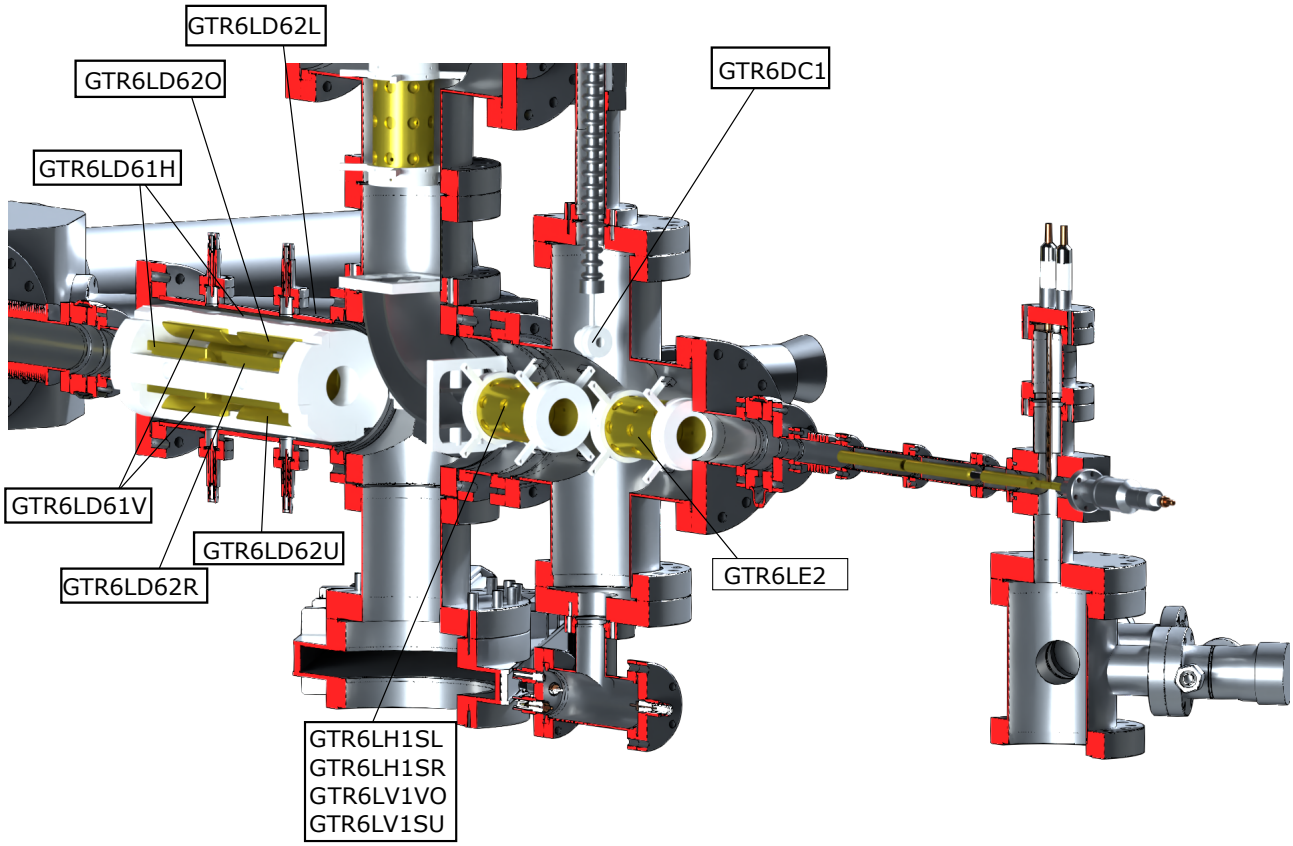

Figure 6: Electrode structure of HITRAP local EBIT beamline with related nomenclatures assigned.

7 Relation between Nomenclatures and Shared Variables

For controlling the elements described up to here via National Instruments LabVIEW, the GSI-developed “CS-plus-plus” (CSPP) based control system for HITRAP utilizes the National Instruments provided data exchange layer with so-called “Shared Variables” as data-exchanging entity. This document shall not go into the details of CSPP or shared variables. Here, only the assigments between nomenclatures/electrodes and control system entities shall be shown.

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7.1 Variable assignments of Elements in Section GTR5

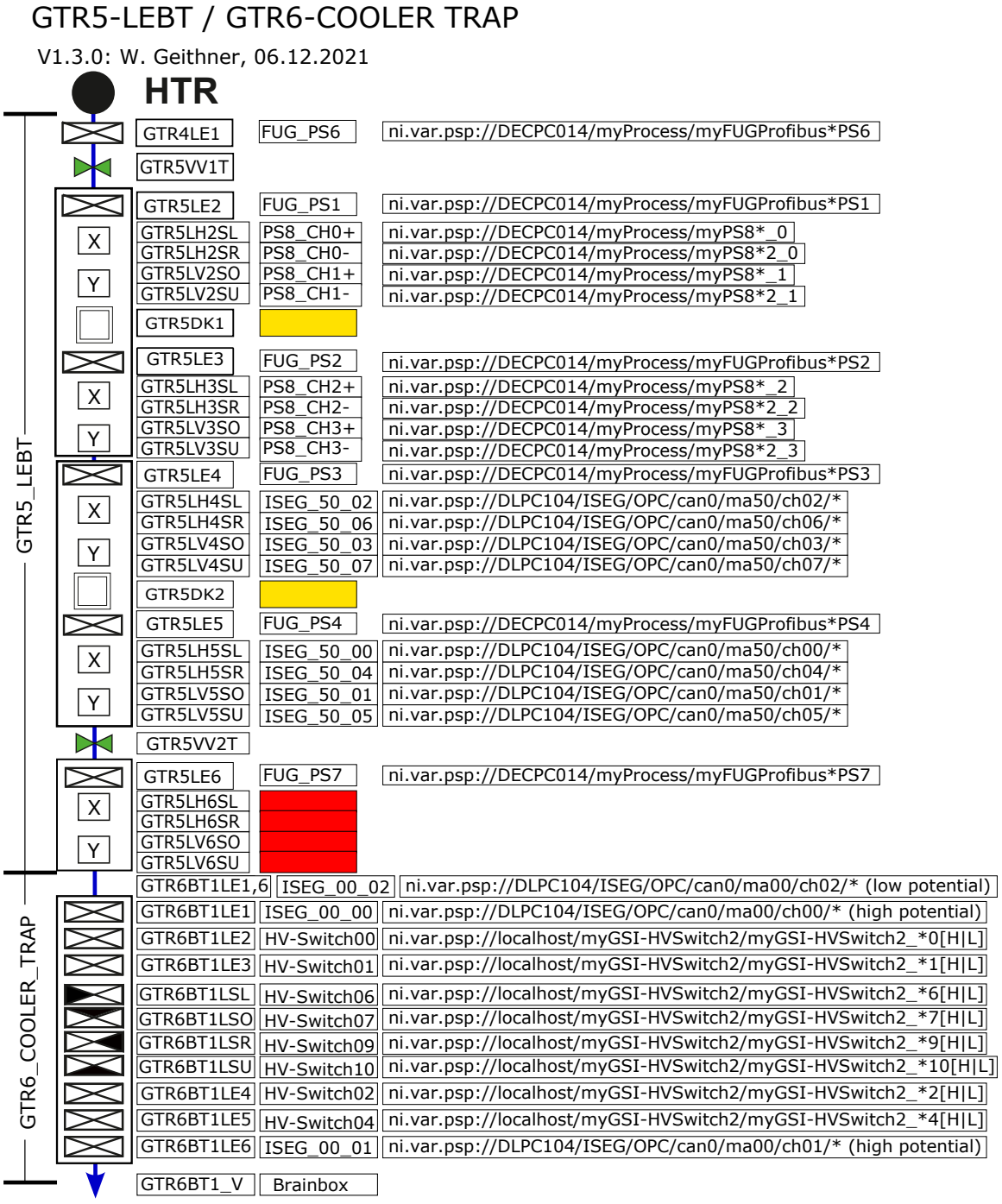

Figure 7: Schematic overview of beamline section GTR5 with beam optics assignments and related Shared Variables in CSPP. Boxes drawn in red indicate missing information/unknown assignment, boxes drawn in yellow are elements controlled via the FAIR control system.

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7.2 Variable assignments of Elements in Section GTR6

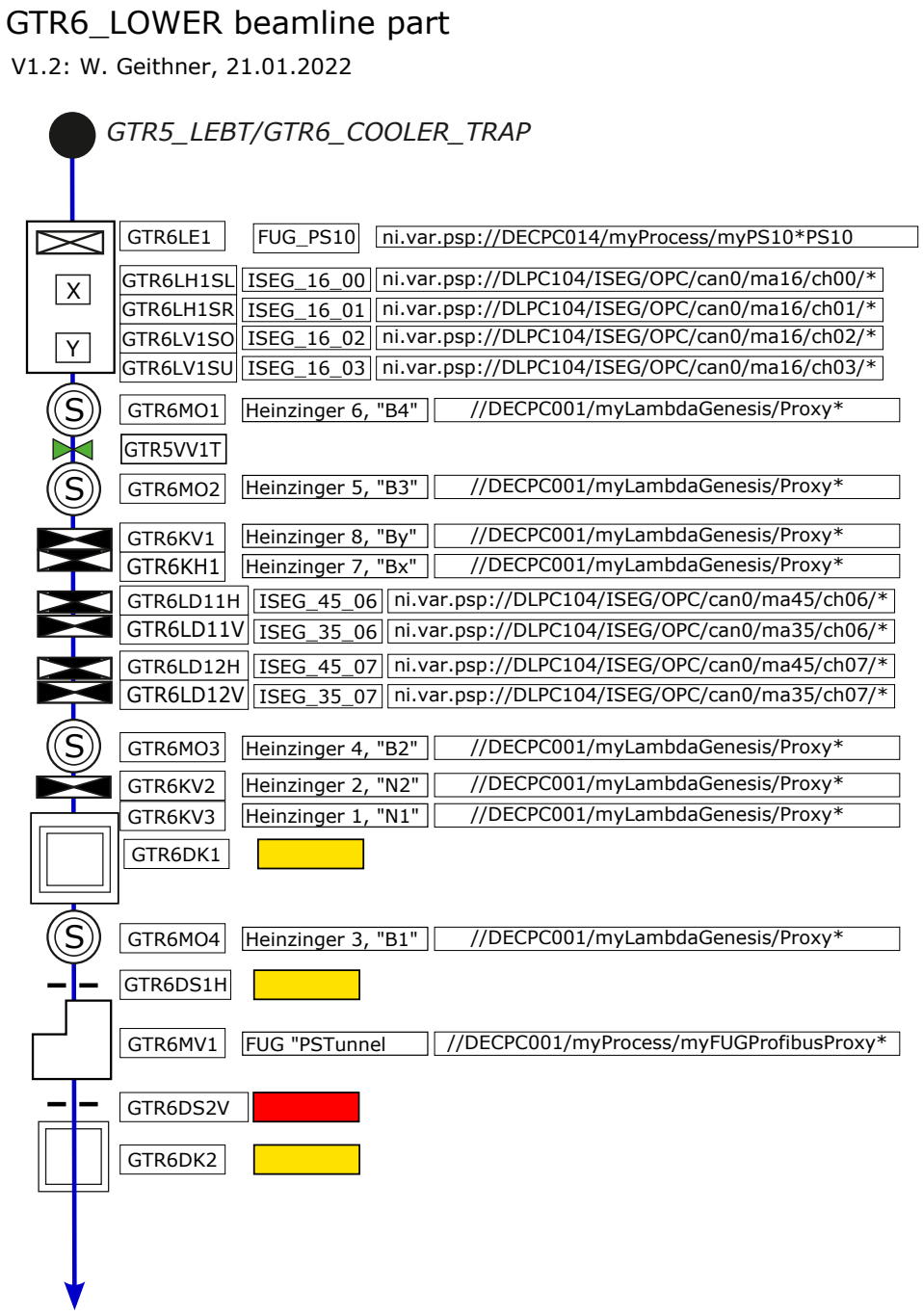

Figure 8: Schematic overview of beamline section GTR6 (lower beamline elements) with beam optics assignments and related Shared Variables in CSPP. Boxes drawn in red indicate missing information/unknown assignment, boxes drawn in yellow are elements controlled via the FAIR control system.

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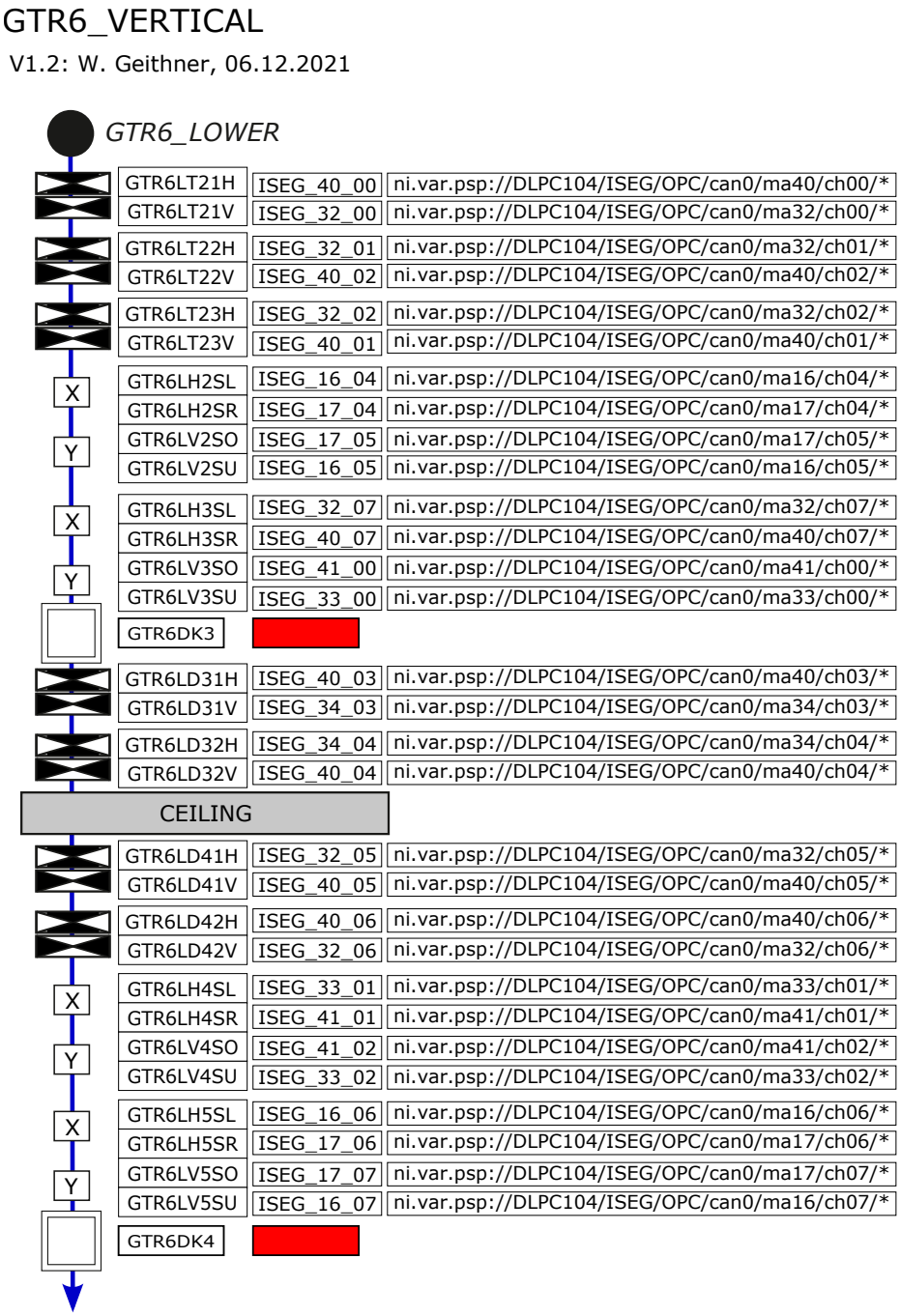

Figure 9: Schematic overview of beamline section GTR6 (vertical elements) with beam optics assignments and related Shared Variables in CSPP. Boxes drawn in red indicate missing information/unknown assignment, boxes drawn in yellow are elements controlled via the FAIR control system, elements where assignment needs to be checked are marked orange.

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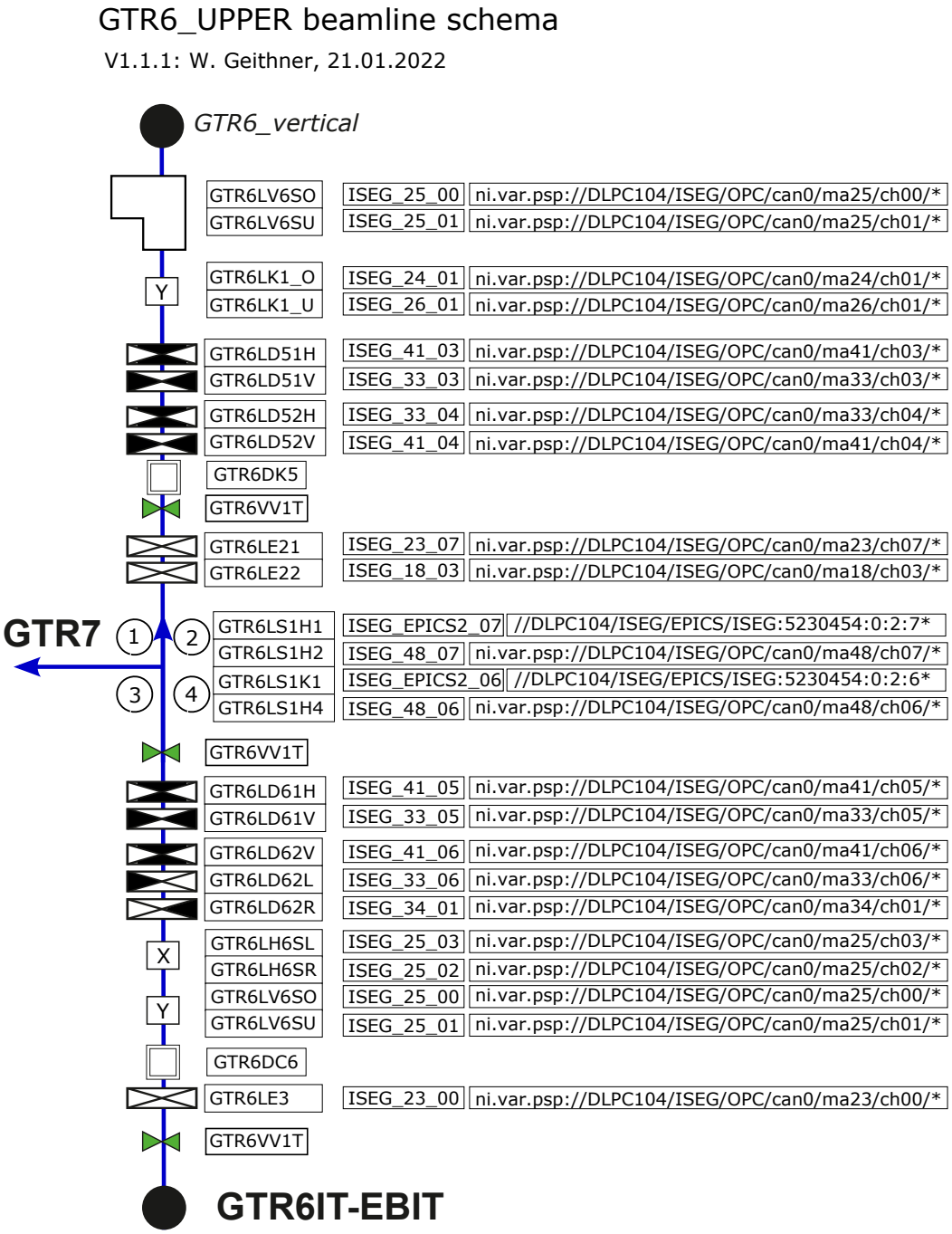

Figure 10: Schematic overview of beamline section GTR6 (upper beamline) with beam optics assignments and related Shared Variables in CSPP. Boxes drawn in red indicate missing information/unknown assignment, boxes drawn in yellow are elements controlled via the FAIR control system.

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References

[1] Nomenclature drawing of the HITRAP beamline and facility, export from CATIA (2008-02-15)
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[2] Strahlwegeplan/-liste für die ESR-HITRAP beamline Abschnitt GTR1:
https://websvcpro.acc.gsi.de/groups/cscosv/belweb/pages/acc-nomen/pages/Section_S0527.html

[3] Strahlwegeplan/-liste für die ESR-HITRAP beamline Abschnitt GTR2 - GTR7:
https://websvcpro.acc.gsi.de/groups/cscosv/belweb/pages/acc-nomen/pages/Section_S0529.html

[4] System for Nomenclatures of Accelerator Devices at FAIR & GSI, version 15.9, 2020-11-20
latest version available at: https://www-acc.gsi.de/wiki/pub/Accnomen/WebHome/acc-nomen.pdf

[5] F. Herfurth, Z. Andelkovic: *Strahlstrecke ESR - HITRAP*, schematic drawing of transferbeamline with FAIR control system nomenclatures, V03 from 24.09.2020
https://git.gsi.de/hitrap1/t-va-dec-0006-en_hitrap_nomenclatureconvention/-/blob/master/HITRAP_SchemaAbschnitteStrahlwege_V04.svg

[6] Excel workbook with HITRAP related nomenclatures and their mapping to LabVIEW shared variables
https://git.gsi.de/hitrap1/t-va-dec-0006-en_hitrap_nomenclatureconvention/-/blob/master/HITRAP_NomenclatureProcessVariableMapping.xlsx

[7] Vector graphics master file of GTR5/GTR6 nomenclature schema
https://git.gsi.de/hitrap1/t-va-dec-0006-en_hitrap_nomenclatureconvention/-/blob/master/HITRAP_SchemaGTR5-GTR7.svg